A preliminary study on total gaseous mercury exchange rate between air and soil in Guiyang, China

HOU YA-MIN[1, 2], FENG XIN-BIN[1,*], QIU GUANG-LE[1, 2], WANG SHAO-FENG[1, 2]

[1]State Key Laboratory of Environmental Geochemistry, Institute of Geochemistry Chinese Academy of Sciences, Guiyang 550002, PR China.
[2]Graduate School of the Chinese Academy Sciences, Beijing 100039, P R China
*Corresponding author; E-mail: xinbin.feng@mail.gyig.ac.cn

Abstract: The mercury exchange flux between air and soil surfaces was measured using dynamic flux chamber method in Guiyang and its suburbs. At the same time, meteorological parameters such as air temperature, soil temperature, humidity, solar radiation, wind direction and wind speed were recorded using a multi-function mini-weather station. The results illustrate that both solar radiation and soil temperature significantly correlate with Hg flux.

Key words: Guiyang; suburb; soil; air; mercury; exchange flux

INTRODUCTION

Mercury (Hg) is a specially highly toxic non-essential heavy metal. It has been considered as a global pollutant due to its ability to undergo long distance transportation in the atmosphere. Thus, great attention has been paid to the study of mercury behaviors in the environment internationally since the 1980s. Mercury is emitted into the atmosphere by both anthropogenic and natural sources. Evaporation of mercury from soil is a large atmospheric source[1]. But there are only a few published flux data on air/soil exchange of mercury in China[2, 3].

The province of Guizhou in Southwestern China is currently one of the world's most important mercury production areas. Guiyang city (E106°27', 107°03', N26°11', 26°55') is situated in the central of Guizhou province with the total area of 2406 km^2. Study showed that total gaseous mercury (TGM) concentration in the ambient air of Guiyang is elevated compared to the global background values[4], but the atmospheric emission sources are not well identified though it is speculated that coal combustion emissions are the primary source. In order to evaluate the contribution of atmospheric mercury from soil emission, we conducted an intensive field study on air/soil exchange of mercury in Guiyang city.

From May 21 to June 5, 2003, we measured the Hg exchange flux between air and soil surface using the method of Dynamic Flux Chamber at four sampling site in Guiyang city and its suburb as shown in Fig. 1. At the same time, we recorded data of air temperature, relative humidity, intensity of solar radiation, wind direction and wind speed using a multi-function mini- weather station. Soil samples in study area were also collected.

Figure 1. The locations of the sampling sites.

RESULTS AND DISCUSSION

The mercury concentration in soils at four sampling sites are 0.146 mg kg^{-1}, 0.215 mg kg^{-1}, 0.254 mg kg^{-1} and 0.627 mg kg^{-1}, respectively. It is obvious therefore that soils in this area are contaminated with mercury in some extent because the background mercury concentration in soil is usually less than 0.1 mg kg^{-1}. Total gaseous mercury (TGM) concentrations in the ambient air is relatively high compared to the global TGM background value (1.5-2.0 ng m^{-3}).

The mercury exchange rates at Institute of Geochemistry and Yanlou site are higher than that of Hongfeng Reservoir region in summer (27.4 ng $m^{-2}h^{-1}$)[3]. The mercury exchange rates at Qingyanbao and Ganzhuang are however lower than that of Hongfeng Reservior in summer. At four sampling sites, day deposition of mercury from air to soil surface occurred frequently. Mercury flux between soil and air varied with time and the flux reached peak at noon and then decreased to the minimum before the sunrise.

It is widely accepted that mercury emitted from soil is mainly Hg(0) and at most a small portion of dimethyl mercury. Factors controlled Hg(0) evaporates from soil is various. Physical parameters, such as temperature, radiation or moisture, can promote the production of volatile Hg species since they induce or stimulate these chemical forma-

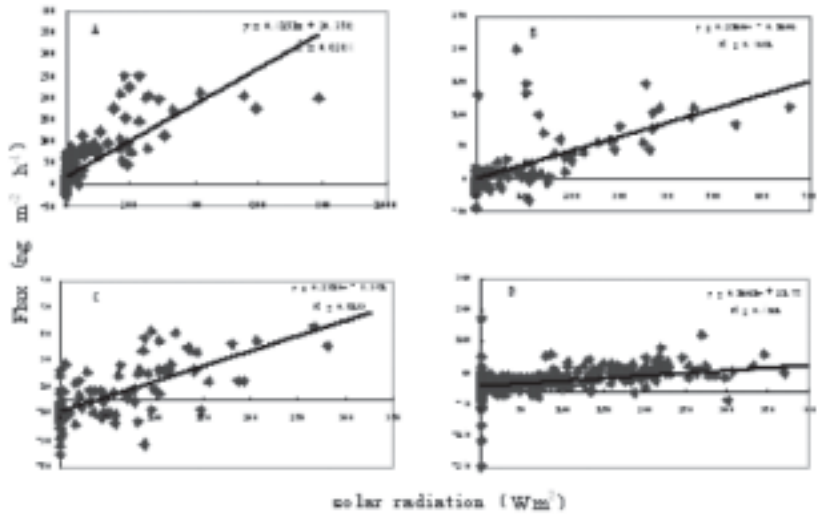

Figure 2. Relationship between mercury flux and solar radiation: **A** Yanlou, **B** Qingyanbao, **C** Ganzhuang, **D** Institute of Geochemistry, Chinese Academy of Sciences.

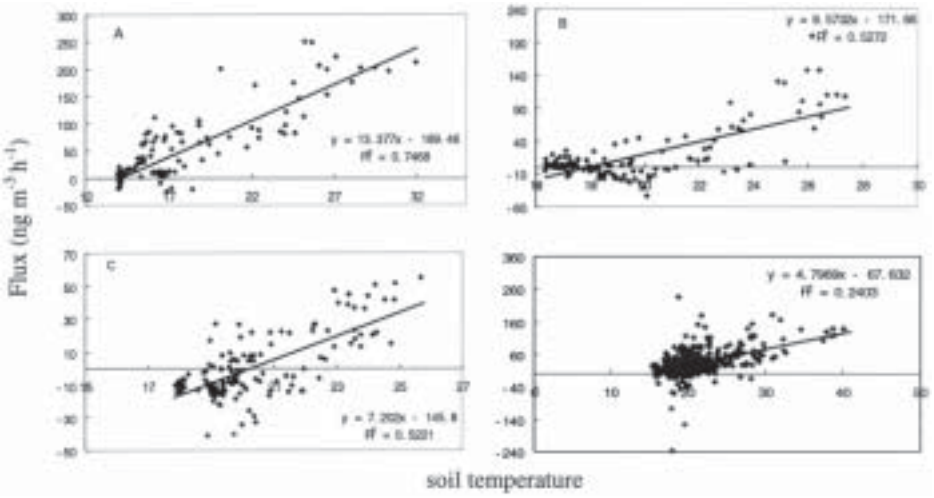

Figure 3. Relationship between mercury flux and soil temperature: **A** Yanlou, **B** Qingyanbao, **C** Ganzhuang, **D** Institute of Geochemistry, Chinese Academy of Sciences.

tions. Thus, the correlations between mercury flux and meteorological parameters are very important.

Our data showed a good correlation between mercury flux and solar radiation, soil temperature as shown in Fig. 2 and Fig.3.

CONCLUSIONS

Mercury emissions from soil generally increase during the day, peak around noon, and decline at night. There are significant correlation between mercury flux and meteorological parameters. Solar radiation is most important in controlling Hg flux at the 4 sampling locations.

Acknowledgements

This work was financially supported by Chinese Academy of Sciences through "Hundred Talent Plan", and also by Chinese National Natural Science Foundation (No. 40173037).

REFERENCES

[1] SCHROEDER, W. H., MUNTHE, J. (1998): Atmospheric mercury – an overview; *Atmospheric Environment* 32, 809-822.

[2] FENG, X. B., CHEN, Y. C., ZHU, W. G. (1996): The fluxes of volatile mercury over soil surface in Guizhou Province; *Environ. Sci*. 17(2), 20-25.

[3] WANG SHAOFENG, FENG XINBIN, QIU GUANGLE ET AL.(2004): Comparison of Air/Soil Mercury Exchange Between Warm and Cold Season in Hongfeng Reservoir Region; *Environmental* Science 25(1), 123-127.

[4] FENG, X., TANG, S., SHANG, L., ET AL. (2003): Total gaseous mercury in the air of Guiyang, PR China; *The Science of the Total Environment* 304, 61-72.